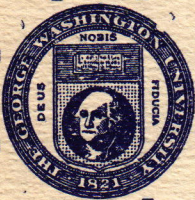


MECHELECIV



THE GEORGE WASHINGTON UNIVERSITY
SCHOOL OF ENGINEERING

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March

1948

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SLIDE RULE JOCKEY'S, OR---?

by CARL H. WALTHER, *Professor of Civil Engineering*

A couple of weeks ago two or three engineering students and I were having a "bull session" in the hall between classes. We were talking about what sort of training an engineer needs and one of the fellows said, "The only important things an engineer needs to know are the science and engineering courses, the tools he will work with in his profession."

Now this is where I have to differ with our friend who made this statement. I said to him about what I am going to write here. Naturally every engineering student wants to finish his schooling as early as he can, so he can begin to earn his living and accomplish the engineering tasks that fire his imagination. But these vocational aspects are only a small part of what an education really means. An engineer needs to know something about a great many subjects that may not seem to be at all related to technical engineering. I mean the humanities and social sciences—literature, history, languages, political science, etc.

We think that our students have learned to think logically about physical problems by the time they are graduated, but the average engineering graduate is not well informed on subjects outside of engineering. Consequently he is in danger of becoming a pretty narrow kind of citizen, because a man's mind is more or less like a computing machine—it works only on what is put into it. Unless he has gained familiarity in non-technical fields he simply does not have the basis for forming the judgments that he, as a citizen, must form every day.

The engineer's training stresses mathematics and physical sciences and often gives little emphasis to the humanities or social studies. This has been true in the past largely because of the pressure of engineering "application" courses. At present, however, there is a growing realization that more general education is desirable.

Anyone can readily see for himself the necessity for

a general education for engineers. There are 168 hours in a week, but only about a fourth of them are spent in the office or shop. Throughout the entire week—four times as long—one is a citizen. The most useful citizen is the educated man, and no man can call himself educated unless he knows how individuals and groups behave. After all, we must live in the society we have created. Literature tells how individuals behave. History and languages interpret for us the behavior of whole nations and societies. Some of the social sciences give an insight into why we react as we do. An educated man has the peculiar brand of sagacity which, to quote William James very roughly, "enables him to know a good man when he sees one." Part of this wisdom can be gotten from studies in the humanities.

Today there exists a greater need for educated citizens than ever before. In the times now unfolding engineers are likely to be in the forefront of the group of educated citizens, because of the increasing role of science and technology in our country's development. It is a truism that the welfare of our nation depends on every man doing what he is best able to do. In the case of engineers this means planning, building—and now, I think, leading. For leaders we need men of more than one talent, men who understand both the motives of people with whom they deal and the physical forces now at our command. It is the task of every engineering student to prepare himself in every way he can for leadership.

One way in which this preparation can be begun is to devote as much academic time as possible to study in fields of knowledge outside of engineering. Of course it will be necessary for you to carry on with study for your whole life after graduation, but it is a good idea to get as much formal study as you can while in school, if only because guided study is easier and gives you a firm starting point for your further reading.

I'd like to see all of our engineering students take their electives in the humanities and social sciences. It is difficult to make any hard and fast statement as to which courses should be elected; there are so many fields of interest and so few electives. Courses in almost any department of the University would be valuable. Among subjects likely to be of particular interest to engineers, history, literature, languages and political science have already been mentioned. Geography is closely related to history. Art goes hand-in-hand with literature in all languages. Economics, sociology, psychology touch at many points. The list could be extended almost indefinitely.

The important thing is: elect some subjects beyond engineering and get started. Your interests will surely grow with your understanding. Pretty soon you'll find that you aren't merely a "slide-rule jockey" any longer. And what's more—it's fun!

REDUCING PIER FIRE HAZARDS

by DAVID C. COLONY, JR.

INTRODUCTION: Waterfront structures are particularly liable to fire damage because of their peculiar location, the nature of their function, and their construction. The usual wind direction in a pier structure is from the cooler water end to the warmer land end, and the long, narrow, unbroken areas of many piers have served as horizontal flues, carrying fires through the structure and its contents with amazing rapidity. The spread is often so rapid that the men working on the pier have no time to escape except by jumping overboard. Pier structures are subject to severe fire hazards, both internally from their cargo and externally from vessels alongside.

In a recent conflagration in New York Harbor, a large passenger liner was removed from a berth adjacent to the stricken Pier 57 to an anchorage in the stream, thus indicating the grave concern of the ship owners over the possible spread of the fire. Spontaneous combustion is always a serious consideration whenever there is a large amount of cotton in the cargo, and even rags are classified as dangerous cargo by port authorities.

The necessary peculiarities of pier design increase the hazard of destruction by fire for two important reasons. In the first place, the land fire fighting organizations have no access to the building except at the narrow bulkhead end. In addition, the common American pier structure on unprotected wooden piles subjects the structure to fire damage from burning material below the pier deck. There have been cases where burning cotton bales and burning oil from broken pipe lines have found their way under the decks of piers and led to serious damage.

A brief glance at the fire record of the Committee on Wharves and Piers of the National Fire Protection Association indicates the magnitude of the problem. In the 50 years up to and including 1939, there were 396 fires with an average yearly loss of 1,424,000 dollars. In the Pier 57 fire previously referred to, the loss has been estimated at 5,000,000 dollars. All but 75 feet of the 1,000 foot structure collapsed into the river during the 15 hour blaze, and the New York City fire department classified it as an eight alarm fire. There were in all, 35 fire bell signals—one of the greatest alarms in the department's history.

Having stated the problem, it is the purpose of this paper to survey what structural features can be embodied in pier construction which tend to restrict the spread of a fire. No-smoking rules and similar administrative problems will not be discussed.

GENERAL CONSIDERATIONS: First, we must distinguish between "wharf" and "pier." A wharf is a structure whose long dimension is parallel to the shoreline. A pier has its long dimension perpendicular to the shoreline.

Most of the remarks in the remainder of this discussion will apply to piers, both because they are most common and because they are most vulnerable to fire by

reason of their long narrow shapes and limited access from land.

In order to perform its main function of shelter for vessels and goods, a pier must fulfill a number of requirements. The structure must be capable of resisting horizontal forces such as the impact of vessels, currents, floating ice, wind, and waves, in addition to its own dead weight and the live load imposed by freight stored within. A pier must also be elastic in construction, and not liable to damage vessels alongside in the many inevitable minor collisions that occur. This requirement has led to the extensive employment of timber, particularly in the substructures, where timber piles possess the advantage over concrete piles of being more easily braced against horizontal blows. In addition, a pier must not obstruct the free flow of water, ice, and sewage, and more specifically, must not diminish the tidal prism, or that volume of water which enters and leaves the harbor with each tide. This volume of water is relied upon in many harbors to dilute and dispose of sewage as well as to minimize dredging costs by keeping the channels scoured.

Equally as important as any technical considerations are the economic factors governing pier design. A useful life of more than 20 years is rarely anticipated for pier structures, since the tides of commerce ebb and flow in such complex patterns that it is difficult to state whether or not a given location in a harbor, or even an entire port, will be nearly abandoned in less than a generation. Consequently, it must be regarded as contrary to the best interests of the community to spend large sums of money on an elaborate structure, no matter how fireproof it may be, or whatever advantages it may possess at the time of construction. This fact must be kept in mind, and it must be realized that minimum cost—considering first cost, maintenance, and payments on bonds—is a prime essential if the pier is to provide the maximum social benefits desired by the community.

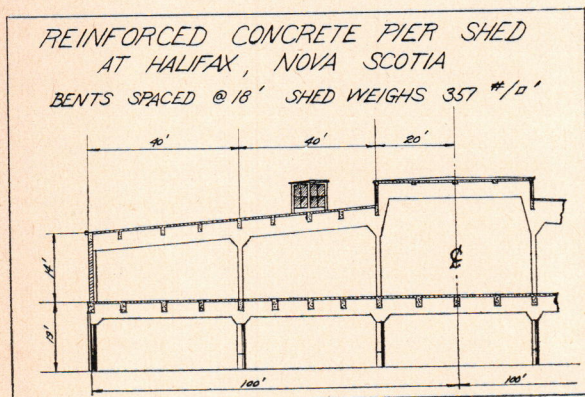
The substructure of a pier presents the most complex engineering problems and also is the most important single factor in influencing the total cost of the entire project. There are three general types of substructures: (1) the solid filled type (2) the block and bridge type, and (3) the pile foundation.

Naturally, the solid fill foundation provides the firmest footing, and on it can be placed the finest type of fire-resistive pier shed, as well as heavy cranes and machinery. A few such piers are in use in this country, having been built for special purposes such as ore handling on the Great Lakes, but solid filled piers are very expensive, and possess the further disadvantage of obstructing the free flow of water. In general, solid fill foundations are impractical for the ordinary pier structure.

In the block and bridge type of construction, cross walls or flat arches of concrete, steel, or wood support

the pier deck and are in turn supported by large blocks of stone or concrete, or by timber cribwork filled with loose stone, resting on the bottom of the harbor. This method is more practical from the economic standpoint, but naturally requires a firm bottom in order to support the large loads imposed by the shed and its contents.

The cheapest, most common, and weakest type of substructure consists of transverse bents of timber piles spaced about every ten feet under the pier. In many ports, as in New York, it is the only practicable method because of the soft mud bottoms encountered. The safe load per pile is usually about 12 tons in New York, although the Department of Docks has conducted tests in the East River and found that loads of about 35 tons could be imposed on the piles without serious settlement. Nevertheless, there are severe restrictions placed upon the weight and the type of superstructure that can be placed on a foundation that depends entirely on the friction between timber piles and soft mud. This problem really is the crux of the fireproofing situation as far as piers are concerned, and is the one all important factor that makes fire protection in piers so much more difficult than in structures upon a more substantial base.

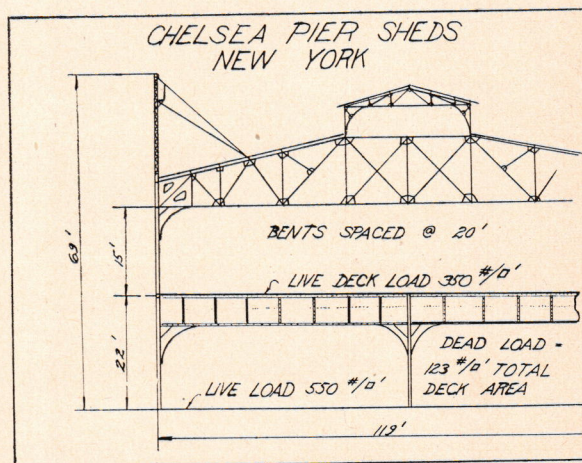


FIREPROOF SUPERSTRUCTURES: With the foregoing considerations well in mind, we may now proceed to a discussion of the pier sheds themselves. In speaking of fireproof structures, the term "fireproof" must not be confused with "incombustible." A "fireproof" or "fire resistive" structure is one which is not subject to complete destruction by fire by reason of the properties of the material composing it. Thus, the National Board of Fire Underwriters recognizes reinforced concrete as a "fire resistive" material, suitable for use in marine structures, whereas unprotected steel framing, although incombustible, soon collapses under the high temperatures generated by a fire in the cargo, and effectively prevents the entrance of firemen to the structure, causing the complete destruction of pier and contents. Unprotected steel framing is specifically warned against in the Underwriter's "Recommendations."

There are, however, three types of shed construction approved by the Underwriters. The first is labelled "Class A," and designated as "Fire-Resistive." In order for a shed to be considered "Class A," it must have side and end walls consisting of at least 8 inches of reinforced

concrete, doors with fire resisting qualities equal to a standard fire door, capable of being closed by one man, and all windows of wired glass in metal frames. If steel columns and girders are used, they must be covered with a minimum of 2 inches of concrete, and the roof must be a reinforced concrete slab at least 3½ inches thick. Steel truss members must be covered with 2 inches of the Underwriters state that it should be used with "Class A" substructure—solid fill, block and bridge, or concrete piles. They make the further statement that, "It is true that in some localities bottom and harbor conditions have prevented the more substantial and permanent construction, and will continue to do so until some genius perfects a design for substructures that will overcome these adverse conditions."

In order to gain a better idea of the relative weights of "Class A" construction and the more usual type, the writer estimated the weights of three piers from drawings given by Greene, (see bibliography). The first, one of the Chelsea Piers in New York, was a typical steel framed, two story shed of fairly large size, resting on the usual wooden friction piles. The roofing consisted of wooden planks, covered by layers of felt, tar, and gravel, and the weight of the roofing and steel framing was computed at 123 pounds per square foot. The other two piers were two story reinforced concrete structures fulfilling the Class A requirements in all respects; one located at Halifax and the other at Havana. The weights of roofing and concrete frames were 357 pounds per square foot and 318 pounds per square foot respectively. From these weights it is easily seen that the Underwriter's "Class A" construction is justifiable only for monumental structures whose commercial life will be much longer than that of the average freight pier.



We have as an alternative to the "fire-resistive" construction, the "non-combustible," or "Class B" type, which may consist of side and end walls built of corrugated iron, corrugated asbestos (transite) or "equivalent material" fastened to an incombustible structural framework.

Corrugated asbestos would seem to have better properties for pier siding than corrugated iron. The Johns-

(Continued on page 6)

WITH OUR SOCIETIES

A I E E

The January meeting of the AIEE, held jointly with the IRE featured Mr. W. G. Hills of the Electric Institute of Washington.

The National President of the AIEE, Blake D. Hull, visited one of our laboratory sessions in action, when he came to address the Washington Section. President Hull commented that in other colleges he had recently visited, there were more communication engineers than power majors; however, it was revealed that the distribution in both fields is nearly equal at G. W. He concluded his visit by wishing the group luck and saying that there are many good opportunities in the engineering field, but only the better men will acquire the more fruitful positions.

Professor Antel, our advisor, announced that the prize paper contest sponsored by the AIEE is now open to its members, and papers should be delivered to Professor Antel as soon as possible. The contestants from George Washington University will be judged by three members of the Washington Section. The winner will receive a trip to Columbus, Ohio to the Second District Contest in May, membership to the AIEE, and a cash prize. The winner of the District Competition will receive a trip to Mexico City to the AIEE Regional Meeting in July.

THETA TAU

Following Dr. Frank Jewett's enlightening lecture on February 11, Theta Tau held a reception for honorary member Frank A. Howard, sponsor of the Howard Lecture Series.

A Theta Tau Gear made by Vince Hennessey was presented to Mr. Howard in an informal ceremony at the Roger Smith Hotel.

By the time this issue reaches the streets we will have had our birthday initiation and dance on March 20. Initiates will be Matt Flato, Matt Polk, Bob Koche, Al Tinklenberg, Jack Glessner, Charles Appel, Walter Cole, Norman Miller, Claude Dimmette, Merritt Downing, Glen Ballow, and Burr Latta.

Brother "Scotty" Ebrite claims that Brother "Hot Lips" LeCroy, Star of the Engineer's Ball, had the unfair advantage of holes in his socks.

SIGMA TAU

At a recent meeting of the chapter it was voted that starting this year a banquet will be held annually on April 18 or the nearest Saturday thereto, to commemorate the Installation of Xi chapter into Sigma Tau Fraternity. Xi chapter was founded at the George Washington University on April 18, 1921.

Each year Xi chapter awards a medal to the engineering student achieving the highest scholastic record as a freshman. This year's award will be made in the spring.

A S C E

Our program for the January meeting featured the film entitled "Floating Drydocks." This two reel film depicted the development and use by the Navy of floating combat drydocks. Perhaps the most unusual of these was a reinforced concrete dock. The greatest was a ten section job, capable of servicing battleships, and aircraft carriers. These big babies have a lifting capacity of 100,000 tons. The docks were closely guarded secrets during the war, but have now been released as a stimulus toward professional interest.

The business meeting included a preliminary discussion of features to be included in the Maryland-District of Columbia Conference session on January 10. Charles Appel, Irvin Liljegren, and Don Blanchard, our Conference Committee, will meet with delegates from Johns Hopkins, Maryland University, and Catholic University to settle details and plan a tentative program. The plans to date indicate that the four chapters will get together on April 24 at G. W. U. to continue the annual conference of the Student Chapters of the ASCE that the late war interrupted.

The March meeting of the ASCE featured a very interesting film entitled "Saudi Arabian Oil" produced by the Arabian-American Oil Co. It pictured the progress made by American engineers in teaching the Arabs the intricate task of drilling for oil. Americans and Arabs worked side by side in complete harmony. The benefits derived from American management were shown by the increased facilities and higher standard of living in Arabia.

During the business meeting the social committee announced plans for a stag party to be held Saturday, April 3d. The fun starts at 8:00 P. M. at the home of Buddy Dimmette, 6227 9th Street N. W., corner of 9th and Sheridan. Entertainment will be provided via television. Plenty of refreshments will be on hand, but we do need poker chips.

Plans for the coming conference were discussed next. Three field trips have been suggested as follows: Army Map Service, David Taylor Model Testing Basin, and the Naval Ordnance Lab. The conference has progressed very rapidly and the program looks very enticing.

Students papers will be read at the April meeting. The papers may be upon any engineering subject, and a time limit of 15 minutes for graduates and 10 for undergraduates has been set. The graduating students will compete for a year's free membership in the parent society, while the undergraduates will try to win an Engineering Handbook of their own choice. All members are urged to compete for these worthwhile prizes. Just get in touch with the President, Erb Liljegren, before the April meeting.

ASME

Mr. Charles Kottcamp of the Locomotive Development Committee, Bituminous Coal Research Inc., gave a discussion of the coal-burning gas turbine at the January 7th meeting of the chapter. Mr. Kottcamp first listed the requirements of a locomotive. From there he traced the development of the coal-burning gas turbine to the present time. Some of the requirements or problems as given by Mr. Kottcamp were: smoke, ash removal, 1,000 mile range, and the use of the same coal as present steam locomotives use with no additional duties given to firemen other than those they now perform.

In general the process follows this pattern: (1) drying, (2) pressurizing, (3) combustion, (4) ash removal, (5) sending the gas to the turbine. Mr. Kottcamp spoke of this sequence as "The pressurized combustion of pulverized coal."

A comparison of relative advantages of both coal as used in present vapor cycles, the diesel and the new coal-burning gas turbine was given. Cost of coal per B.T.U. available is approximately $\frac{1}{3}$ the cost of Diesel Fuel.

The March meeting of the ASME featured five student speakers competing for the prize of a handbook and a free trip to the Regional Student Convention at Lehigh in April.

Elmer Sunday, who spoke on "Underground Gasification of Coal," emerged as the winner. Runner-up was Ben Sorin, who spoke on "Guided Missiles." The other contestants, who all did fine jobs, were Arthur Brown, speaking on "Torque Converters," Herb Murray on "Locomotive Streamlining," and Stan Russell on "Silicones." Congratulations to the winner.

April 17-18 will be the date for the Convention. See you at Lehigh.

IRE

Mr. W. G. Hills of the Electrical Institute of Washington gave a talk on "The Cooperative Movement in the Electrical Industry." This meeting was held jointly with the AIEE. The February meeting was not held due to the Frank Howard lecture on Industrial Research. The next IRE meeting was held in March, again jointly with the AIEE. Conder C. Henry, Manager, Washington Patent Division, RCA, was the speaker.

Gerard R. Jetton—

Having a B. S. in Engineering, Mr. Jetton is now attending the Harvard Law School. This raises a, "Who came first, the chicken or the egg?" question. Is he going to Harvard because his girl is going to Radcliffe or vice-versa?

Alumnews by EMANUEL BECK

J. Howard Dellinger—

Dr. Dellinger received the A.B. degree in 1908 and D.Sc. in 1932. He also received a Ph.D. from Princeton in 1913. He joined the Bureau of Standards in 1907 and was named chief of the radio section in 1919. At present Dr. Dellinger is head of the Central Radio Propagation Laboratory at the bureau.

He was chief engineer of the Federal Radio Commission from 1928 to 1929 and has been vice-president of the International Scientific Radio Union since 1934. He also has been chairman of the Radio Technical Commission for Aeronautics since 1941.

Dr. Dellinger is a pioneer radio scientist and first called attention to the disturbance in radio communication caused by solar flares. This is now known as "Dellinger Effect". He is a fellow of the Institute of Radio Engineers and was its vice-president in 1924 and president in 1925.

Thomas Ritchie Edmonston—

Mr. Edmonston received a B.S. in C.E. in 1937 and was elected to Theta Tau while at G. W. He is a partner in the firm of E. P. Knollman Co., concrete constructors of Bethesda, Md. He is a member of Engineers Committee of the Hospital Campaign, the Building Congress and the Washington Board of Trade.

Bernard Bernstein—

B.M.E. in 1947, he is now working on acoustics at the Naval Research Laboratory and teaching thermodynamics to night students at his alma mater.

Stanley W. Lange—

B.M.E. in 1948, Mr. Lange is now working with the Army Security Agency. He is teaching mechanical laboratory in the evening classes in the School of Engineering here.

Lou H. Berkley—

Mr. Berkley received a B.E.E. in 1943. He was recently named assistant editor of *The Westinghouse Engineer*. Mr. Berkley is an old staff member of *Mecheleciv*.

Harold A. Wheeler—

Mr. Wheeler received a B.S. in 1925 as a Physics major. At that time there were no courses in communication. However Mr. Wheeler now is president of Wheeler Laboratories, Inc., which do research in radio. He pursued post-graduate studies at Johns Hopkins University and lectured there from 1926 to 1927. Previous to opening his own business he was vice-president and chief consulting engineer of the Hazeltine Electronic Corp.

Mr. Wheeler is a fellow of the AIEE and IRE and a member of Sigma Chi. He received the Morris Liebmann Memorial Prize in 1940 and was a member of the board of directors of the Institute of Radio Engineers from 1940 to 1945.

(Continued from page 3)

Manville Co., manufacturers of transite, claim for their product a resistance to fire superior to that of any other building material. They state in addition that the material is unaffected by rain, salt corrosion, chemical vapors, alternate dry and wet conditions and low temperatures. The fact that transite needs no paint, and can be nailed, screwed and sawed like wood all indicate the economy to be effected by its use. Its drawback for use on piers is the fact that it is not very resistive to impact or even small concentrated loads, which might be caused by vessels alongside or by trucks and automobiles on the pier. The manufacturers have, however, published several photographs of pier sheds built of corrugated transite and a partial list of piers where transite is employed for roofing or siding.

In the case of "Class B" construction, the Underwriter's "Recommendations" simply state that steel frames should be of ample size for loads calculated with the customary factor of safety, while roofs should be reinforced concrete or reinforced gypsum.

"Class C" or "combustible" construction is widely used on the West Coast where timber is comparatively cheap and plentiful. Heavy timber construction is very economical for piers with a short commercial life and in many cases has lasted longer in fires than unprotected steel frames. Heavy timber construction has long been referred to as "slow burning" construction, but in order to meet the requirements of the Underwriters, siding must be at least 2 inches thick and must be nailed to

studding at least 3 inches in least dimension. Columns, girders, and floor timbers must not be less than 8 inches in least dimension and roof planks must have a minimum thickness of $2\frac{1}{2}$ inches, while roof timbers have to be 6 inches thick.

By far the majority of American pier sheds are built according to the "Class B" specifications, although most of the older structures were designed with a total disregard of the fire hazard. Since it does not seem practical to construct a truly fire resistant shed, it is necessary to provide some means of localizing the blaze once it has started in a combustible structure and preserving as much as possible of the valuable contents of the shed. We must now consider these devices in detail. **PROTECTION OF COMBUSTIBLE PIER SHEDS:** It has been pointed out previously that land fire fighting equipment has access to a pier shed only at the narrow bulkhead end, and that the shed usually acts as a horizontal flue which can whip a small fire into a raging inferno in very short order. Many times in the past, fire departments have arrived too late to be able to effect an entrance to the structure and their efforts were confined to pouring water in from outside. The National Board of Fire Underwriters says that, "Where an intermediate wall or partition or several intermediate partitions can be provided, even though the partition is not of a character that would withstand a severe fire for more than 30 minutes, it would give the firemen a vantage point from which they could more effectively fight the fire."

The Underwriters suggest a much more substantial type of fire wall in their "Recommendation for Good Practice." They suggest that fire walls of reinforced concrete 12 to 16 inches thick should extend from deck to roof in Class A and B structures and 3 feet above the roof in Class C structures, and that all fire walls should be extended below mean low water level if the structure is built of combustible material — as is usually the case. Stairwells, elevator shafts and chutes should be enclosed by 4 inches of reinforced concrete, and all openings in fire walls must be protected by fire doors conforming to the Underwriters specifications. Doors must be especially designed for extra strength if their areas exceed 120 square feet, and if the openings are above railroad tracks, special sills must be provided flush with the top of the rails. The "Recommendations" suggest further that the wall should be placed at intervals not exceeding 300 feet and that the maximum area under such spacing should not be greater than 50,000 square feet. It is pointed out in the same publication that pier sheds have been built with unbroken deck areas in excess of 500,000 square feet.

The subdivision of deck area tends to reduce the efficiency of cargo handling and stowage on the pier, especially when the fire walls or fire doors interfere with the movement of railroad cars and motor vehicles. Ship-owners insist on rapid cargo handling, since their vessels earn money for them only when they are actually trans-

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From Under the Tables

"Arcs leaped from the Jacob's ladder as determined engineers clutched reluctant (translation: eager) dates and tested their osculatory response while a few rednosed characters blearily stared from under the tables." That's how our esteemed contemporary, the Hatchet, would describe the Engineer's Ball. They would be right, in a genteel sort of way.

Hundreds of the slide rule slaves threw off their fetters for the night and relaxed to the soothing music of the Alaskans. Undoubtedly a success, the Ball is a credit to the hard-working committees of the Engineer's Council. Ben Sorin was an excellent M.C., particularly with the P.A. system off. Dwain Craig's advertising lured the people in droves. Reid Mayo was reported to have arthritis in his right hand from clutching so many lapels in peddling tickets.

Unquestionably Nygard's electronic brain child was the feature attraction, but the romantic atmosphere was enhanced by the dancing and the flow of "conversation." Kissometer victors were Doris Toombs and her date, James Le-Croy. To quote Doris, "It was all in the technique," (hmmm!), but James, the dreamer declares that the meter responds to passion only.

Scotty Ebrite managed to crawl on his knees to a cab. At 2 A.M. three civils were heard, still outside the Hotel Washington, trying to guess what kept the strapless evening gowns up. According to Professor Walther's theory of structural design the beams were overloaded. Professor Walther wasn't, but most people were.



The ballerina length skirt made its appearance and a junior M.E. was heard to remark that the dresses aren't longer. The women just fit further up in them. This study of engineering will be continued next year after an appropriate review.

(Continued from page 6)

porting freight; and time in port only contributes to overhead costs. The tendency has naturally been to make the unbroken, unrestricted deck area as large as possible to allow the most rapid unloading of vessels and convenience in sorting the cargo. But the danger of total destruction of pier and contents by fire increases sharply with large deck areas and shipowners must be convinced, if they are not already so convinced, that the fire threat is a serious one, and that they will pay for added cargo handling efficiency in heavy fire loss, or high insurance charges at least. Subdivision of pier sheds according to the Underwriters' recommendations is absolutely essential to a balanced design. The development of one characteristic of a structure to the exclusion of other important features is not sound

engineering practice.

Before leaving the subject of interior subdivision, we should call attention to the use of certain boards, draft stops, or smoke baffles between fire walls. The Underwriters recommend that curtain boards be located between fire walls at intervals not exceeding 100 feet and that they should be erected according to the requirements of local building codes. These features usually consist of light walls or partitions extending downward from the roof to a point just above the lower chords of the roof trusses. They run both transversely and longitudinally, and their purpose is to mitigate the horizontal flue effect in a large pier by baffling the flow of smoke and combustion gases through the building.

All types of interior subdivision tend to restrict

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the spread of a fire once it has started, but an automatic sprinkler system can often stifle a blaze before it can become serious. It has been estimated that over 50 billion dollars worth of property in the United States is protected by automatic sprinkler systems and that the fire loss on such property has not been more than 10% of what it would have been without sprinkler protection. Fire losses in sprinkler protected industrial property have been estimated at 2 to 3 cents per hundred dollars property values per year, and annual savings from fire losses at 200 million dollars. The port of New Orleans has learned the value of automatic sprinkler systems for its eight miles of wharves. Prior to the year 1931, the annual fire losses of that port exceeded a million dollars. In 1931, the Dock Board provided complete sprinkler protection for the entire underdeck space as well as the sheds. The installation required 112,478 sprinkler heads, probably the largest single installation in the world, but the city has found that the system has more than paid for itself in reduced fire damage and uninterrupted shipping along with industries dependent upon it.

The Fire Underwriters suggest the installation of a complete system of outside open sprinklers, or water curtains, for walls, roofs and cargo doors. They recommended that standpipe lines should not be less than six inch diameter, or eight inches for piers longer than 500 feet, and that hose connection should be at one hundred foot intervals or less. The port of New Orleans supplies its sprinkler systems from large city mains which parallel the waterfront, and drive an emergency secondary supply from the fire department hose connections. A permanent organization is maintained by the Dock Board to service the sprinkler equipment, with at least one man on duty continuously.

Roof hydrants are useful in fighting fires in vessels alongside and the Underwriters recommend that they be placed on the roof at two hundred foot intervals or less. Facilities should be provided at both ends of the pier for access to the roof, and hatchways in the roof are required at each roof hydrant.

Port authorities and private owners of waterfront property have discovered through experience that adherence to these principles can save lives, money and valuable property. It still remains, however, for most of our major ports to adopt rules and methods of supervision for pier construction and to provide adequate fire protection for existing structures. The latest report of the Committee on Piers and Wharves of the National Fire protection Association states that fire regulations have been adopted in 30 ports, either as separate ordinances or as part of the building codes, but that the value of the regulations compared to the recommendations previously outlined was good in four ports, fair in six ports, and poor in twenty ports. Six major ports had no regulation at all. The final conclusion reached by the Committee was that there is a serious deficiency in regulations and supervision and that about 85% of pier substructures are subject to total destruction, with conse-

quent destruction of superstructures and cargo. Eighty-three per cent of superstructures were found to be non-fire resistive or without automatic sprinklers.

NEW DEVELOPMENTS IN FIRE PROTECTION: It seems appropriate to close this paper with a few brief remarks about some new developments in fire protective materials and devices which might be applied to advantage to marine structures.

One interesting apparatus is a fire alarm which may have its detecting element as much as one hundred feet away from the fire. The National Board of Fire Underwriters says that the alarm, once actuated by radiant heat, can sound an alarm bell, close a circuit which will warn the fire department, or turn on a sprinkler head. The alarm can warn of incipient danger before the fire starts because of its sensitivity to the radiant heat of a chemical reaction, such as the spontaneous combustion of ammonium nitrate, which caused the Texas City disaster.

In conjunction with this alarm, buildings of the future might be equipped with a new high speed sprinkler which can turn itself on within 2 or 3 tenths of a second after a fire starts. The fastest standard sprinkler now in use requires 3 seconds to start.

Light weight vermiculite plaster should prove to be a boon on pier structures where weight is such an important consideration. Its sponsors state that properly mixed vermiculite plaster, having a dry weight of not over 3¼ pounds per square foot, one inch thick, is entitled to a high rating for fire protection of steel structures. In support of their assertion they give the results of extensive tests on an outdoor structure 13' × 20' interior dimensions, built to comply with the Administrative Building Code of the City of New York. This building was subjected to heat produced in a furnace according to the standard time-temperature curve prescribed in the code. After 4 hours and five minutes, the temperature reached 2007° F. The temperatures of all but one steel column remained below the prescribed limit, and won the highest fire-resistance rating. The test structure was also subjected to hose stream and static deflection tests, the results of which have not yet been published by the New York Bureau of Standards and Appeals.

A development which may become useful in the future is the impregnation of wood in a mixture of ammonium and boron salts, chromate and zinc chloride. When the wood is subjected to flame, the ammonium salts give off gases which tend to smother all oxidation. The boron salts release water crystallization which cools the lumber, and when completely fused form an oxygen-repellent glaze over the surface. Wood treated with the mixture is stated to withstand an hour's exposure to a flame up to 1700°F. without igniting. The chemical impregnation is also supposed to render the wood resistant to rot, a necessary requirement for wooden pier structures exposed to such extremes of weather conditions.

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The future may witness the more extensive application of these and other materials to marine structures. It is to be hoped that the design and construction of wharves and piers to replace those now in service will be based upon a more careful consideration of the fire risk than has been the case until now. Our port facilities are essential to the maintenance of world trade, and indirectly, therefore, to the maintenance of world peace.

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